Análise de séries temporais

por similaridade e alinhamento não linear com Dynamic Time Warping

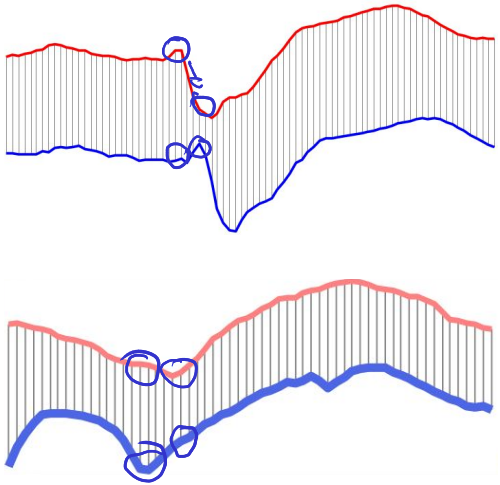
PETROBRAS ufscar DC MIDAS

A DTW!

Dynamic Time Warping

Relembrando

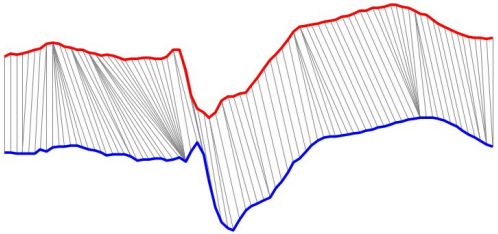
Distância Euclidiana



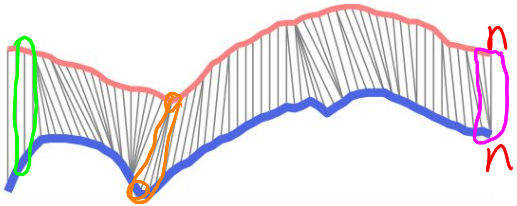
Alinhamento **linear** entre séries temporais *x* e *y* de mesmo comprimento *n*

$$ed(x, y) = \sqrt{\sum_{k=1}^{n} (x_k - y_k)^2}$$

DTW



Alinhamento **não-linear** entre séries temporais *x* e *y*, potencialmente de comprimentos diferentes



$$dtw(i,j) = c(x_i, y_j) + min \begin{cases} dtw(i-1,j) \\ dtw(i,j-1) \\ dtw(i-1,j-1) \end{cases}$$

DTW

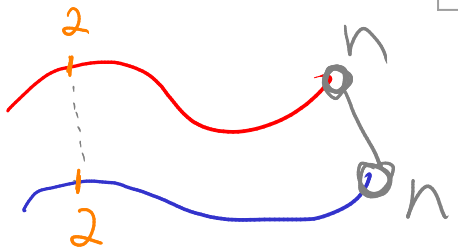
$i \geq 1$

$$dtw(i,j) = c(x_i, y_j) + min \begin{cases} dtw(i-1,j) \\ dtw(i,j-1) \\ dtw(i-1,j-1) \end{cases}$$

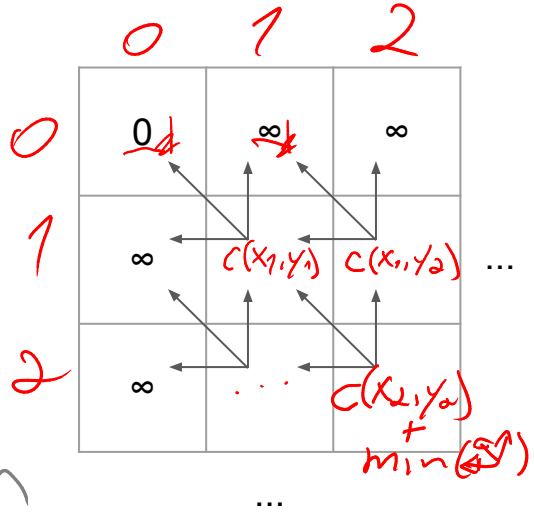
$(x_i - y_j)^2$

Custo

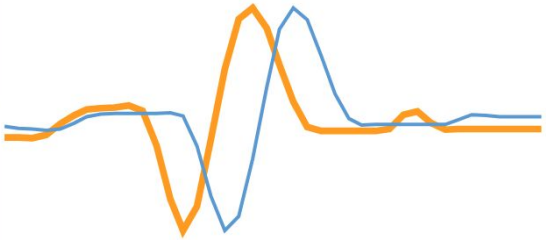
$|x_i - y_j|$

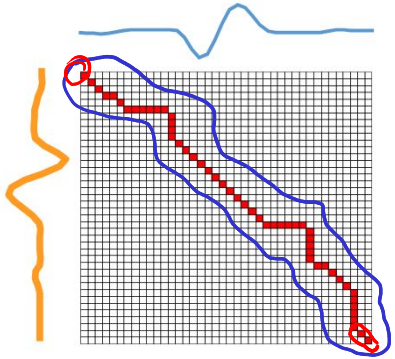


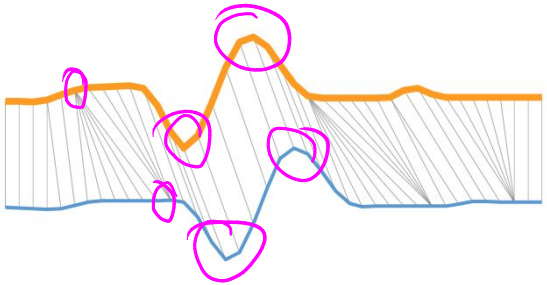
$(n+1) \times (m+1)$



DTW

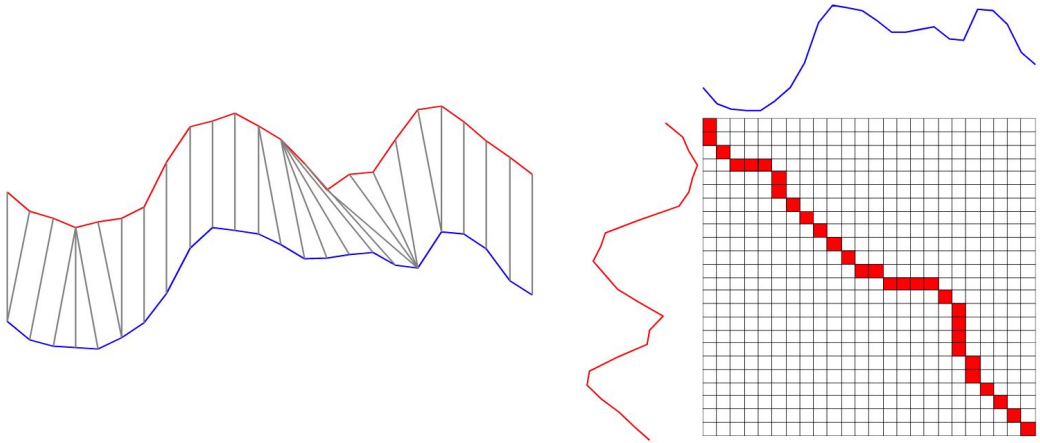




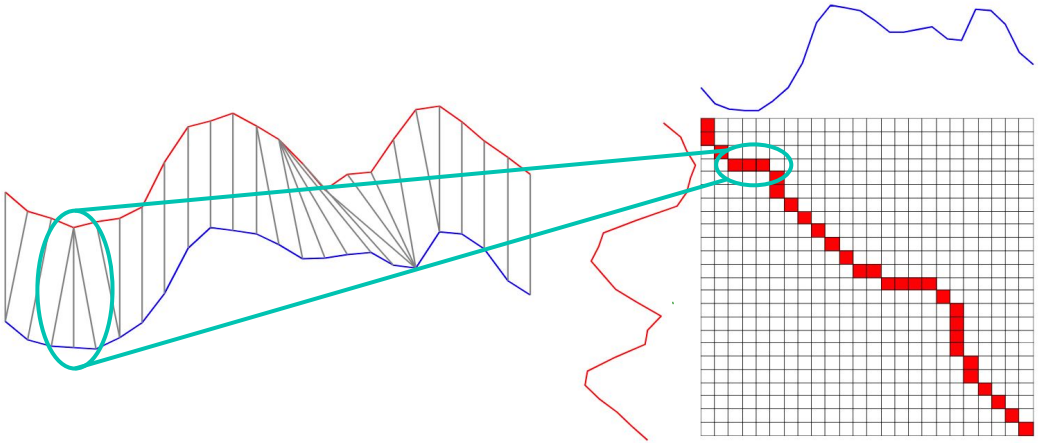


$$D[n][n] = c(x_n, y_n) + \min$$

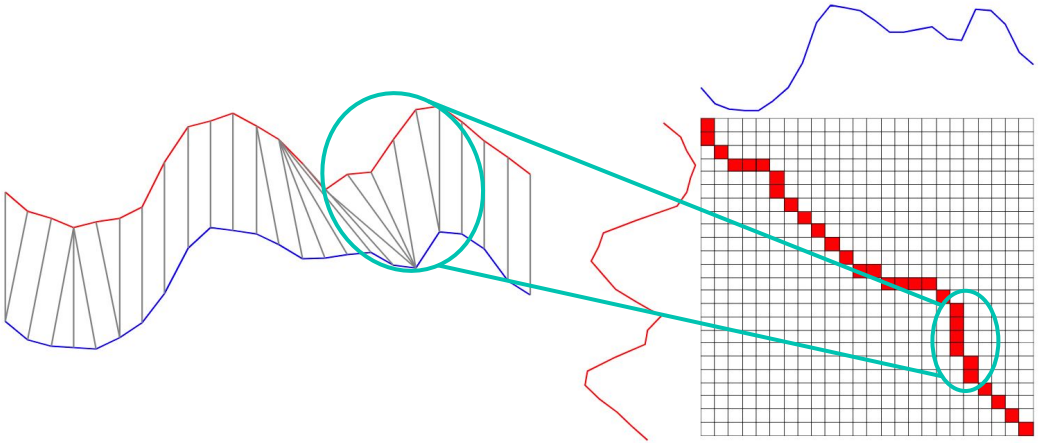
DTW



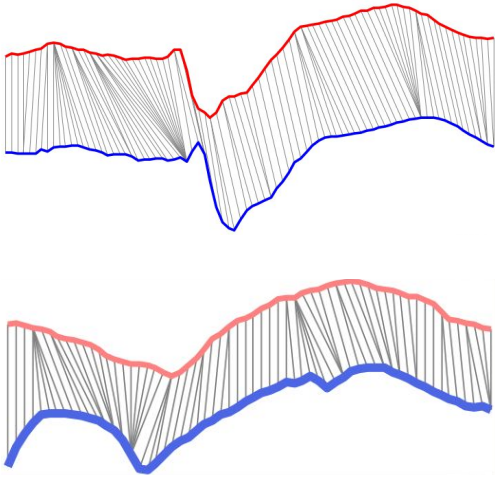
DTW



DTW



Distância DTW



$$dtw(i,j) = c(x_i, y_j) + min \begin{cases} dtw(i-1,j) \\ dtw(i,j-1) \\ dtw(i-1,j-1) \end{cases}$$

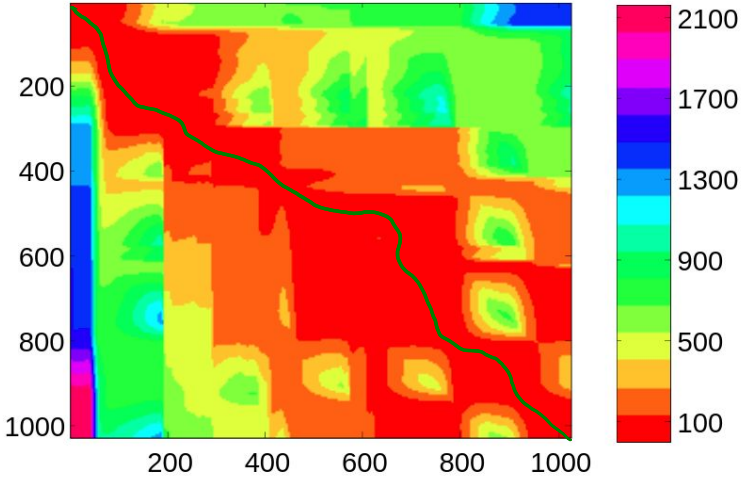
Além do alinhamento, a DTW pode dar uma medida de distância (não métrica).

dtw_dist = dtw(m,n)

DTW - Parênteses sobre o alinhamento

O alinhamento vem de de refazer a rota

DTWED



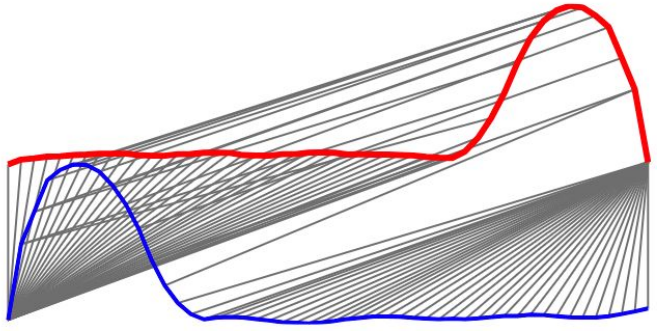
Pruned DTW

DTW

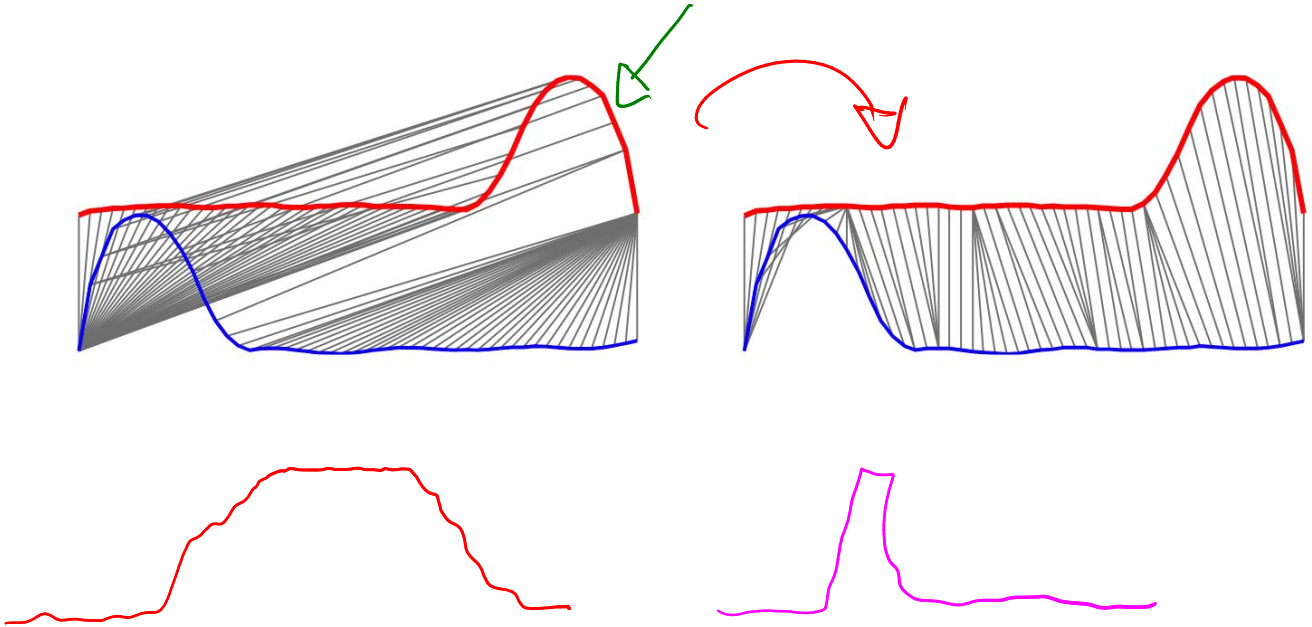
Prática - implementar DTW “na mão”

- Depois veremos ferramentas

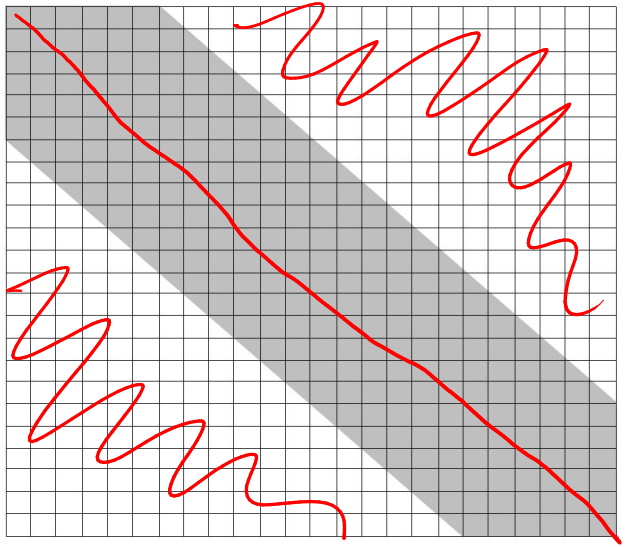
DTW - janelas de warping/restriçōes



DTW - janelas de warping/restrições



DTW - janelas de warping/restrições



Sakoe-Chiba

i, j

i-ésima linha

$j \in (i-r, i+r)$

*Obs: paralelogramo de Itakura